Guidelines for donning, doffing and decontamination of powered respirators	
Situation	Guidelines for air powered respirators do not currently exist for use in NHSScotland; the aim of this SBAR is to present the available evidence to inform the optimum order for donning and doffing and the correct procedure for decontamination. **Due to a lack of available evidence and inconsistency in expert opinion this guidance is to be considered interim and is published in draft.**
Background	In 2016/17 HPS produced a literature review and competency frameworks for personal protective equipment (PPE) for infectious diseases of high consequence (IDHC). The PPE ensembles were based on staff using disposable FFP3 respirators. Concurrently, HPS conducted an annual survey of respiratory protective equipment (RPE) use across NHSScotland to inform the national RPE stockpile. It was found that the use of powered respirators was more widespread than previously thought with 11 of the 15 board that responded using them to some degree. It was subsequently requested by the RPE short-life working group (SLWG) and by members of the National Policy, Guidance and Outbreaks (NPGO) Steering group that enhanced PPE competency frameworks be produced based on ensembles using powered respirators. In order to produce evidence based enhanced PPE competency frameworks a full review of the evidence was conducted. However, insufficient material was identified to produce a literature review. Therefore, minor updates were made to the existing literature review on PPE for IDHC and this SBAR was produced to summarise the relevant national policy, expert opinion and manufacturer's instructions to enable the production of consensus recommendations by the RPE SLWG and NPGO steering group.
Assessment	**<u>Donning and doffing of PPE ensembles that include powered respirators</u>** A targeted literature review by HPS found limited evidence to underpin recommendations for optimum donning and doffing protocols.[1] When producing guidance for Ebola PPE no evidence base was available and recommendations were determined by expert opinion. Any donning and doffing protocols for powered respirators should be based on the existing protocols for IDHC but take into account how the powered respirator will interface with other PPE to form a continuous barrier. Powered respirators may have either an internal respirator unit or an external belt-mounted respirator unit, this may affect the sequence of donning and doffing as ideally the respirator hoods should be removed late in the sequence.[2;3] According to the 2016/17 RPE survey all boards using powered respirators chose models with externally mounted respirator units (unpublished).

	Decontamination The National Infection Prevention and Control Manual (NIPCM) states that manufacturer's instructions should be followed when decontaminating reusable PPE.[4] The majority (80%) of boards using air powered respirators have opted for 3M products for which the manufacturers have provided comprehensive decontamination instructions (unpublished survey results). Manufacturers' guidance is available on the cleaning of reusable filters, however, it has been highlighted that there is limited guidance on the required frequency of filter changes from an infection control perspective. The Health and Safety Executive states that particle filters such as those used in powered respirators should be changed as instructed by the manufacturer; 3M suggest that users *'dispose of or reuse filter/cartridge according to your **infection control policy** and/or* service life determination.' The HSE also state that filters should be changed when: • Damaged or visibly contaminated, • They become harder to breathe through.[5] 3M have summarised the available evidence describing infection risk from filtering face pieces (FFP3s);[6] microorganisms inoculated onto respirator filters have been shown to survive for varying lengths of time (up to 28 days), however there is no evidence to suggest that microorganisms can migrate through the filter. It is suggested that careful consideration is given to filter handling, reuse and storage.[6]
Recommendation	**Due to a lack of evidence the following recommendations will be considered expert opinion and are published in draft.** Before using a powered respirator perform any pre-use checks required by the manufacturer e.g. airflow. **Donning and Doffing PPE ensembles that include a surgical gown and powered respirator with external belt-mounted blower e.g. for aerosol generating procedures** Suggested order of PPE donning 1. Apply non-sterile disposable gloves 2. Apply the disposable, fluid-resistant gown 3. Apply the belt-mounted respirator unit to the waist and buckle securely and comfortably 4. Apply the respirator hood and attach the breathing tube 5. Switch on the respirator unit 6. Ensure the respirator hood is comfortable and secure. 7. Apply a fluid-resistant, disposable apron 8. Apply a second pair of non-sterile, disposable gloves worn over gown cuffs.

Suggested order of PPE doffing

Staff member will leave the clinical area and doff PPE in a designated doffing area e.g. an anteroom.

1. Remove outer pair of non-sterile disposable gloves
2. Remove fluid-resistant, disposable apron by breaking ties at the neck and back and pulling away from the body, touching the inside of the apron only carefully roll or fold into a bundle
3. Perform hand hygiene using alcohol based hand rub ABHR
4. Detach the breathing tube from the respirator hood and carefully remove the respirator hood by grasping the sides and pulling up an away from the face
5. Switch off the respirator unit and unbuckle the respirator waist belt
6. Perform hand hygiene over gloves using ABHR
7. Remove non-sterile disposable gown by breaking the ties and pulling away from the neck and shoulder, touching the inside of the gown only turn the gown inside out by carefully rolling or folding into a bundle
8. Perform hand hygiene over gloves using ABHR
9. Remove second pair of non-sterile disposable gloves
10. Perform hand hygiene using liquid soap and water.

Donning and Doffing PPE ensembles that include a coverall and powered respirator with external belt-mounted blower e.g. for caring for patients with viral haemorrhagic fever (VHF)

Suggested order of PPE donning

1. Don the lower portion of the disposable, fluid-resistant coverall, surgical scrubs are tucked into wellington boots and coverall legs applied over the top of wellington boots.
2. Apply disposable boot covers with ties tucked into the boot cover at the back of the knee.
3. Zip up coverall to the waist.
4. Apply 1st pair of non-sterile, disposable surgical gloves.
5. Pull on upper portion of the coverall ensuring thumb loops are utilised, zip and apply storm flaps
6. Apply the belt-mounted respirator unit to the waist and buckle securely and comfortably.
7. Apply disposable, high-grade apron (buddy will assist).
8. Put on the respirator hood and attach the breathing tube (buddy

will assist).

9. Switch on the powered respirator
10. Ensure the respirator hood is comfortable and secure (buddy will check and record)
11. Apply 2nd pair of non-sterile, surgical gloves, ensure cuffs of the coverall are covered and gloves feel secure

Suggested order of PPE doffing

Staff member will leave the clinical area and doff PPE in a designated doffing area e.g. an anteroom.

1. The HCW will step into the designated doffing area (a large disposable plastic sheet).
2. The buddy will check for any breaches in integrity (tears etc.) or visible contamination and will remove any visible contamination with disinfectant solution or wipe containing 10,000ppm available chlorine before any PPE is removed. Any breaches in PPE integrity should be recorded.
3. Hand hygiene (over gloves) performed using ABHR
4. Remove apron by breaking ties at neck, then back and pulling away from the body, fold into a bundle touching the inside of the apron only.
5. Remove outer pair of gloves
6. Hand hygiene (over gloves) performed using ABHR
7. Buddy unbuckles the waist belt, leaving the unit running
8. Buddy performs hand hygiene (over gloves) using ABHR
9. Buddy loosens the storm flap and unzips the coverall
10. Buddy performs hand hygiene (over gloves) using ABHR
11. Working together, the buddy and staff member carefully remove the coverall by rolling down over the shoulders, turning it inside out as it is removed. The staff member will step out of the coverall and covers, keeping the wellingtons on and standing on the inside out coverall.
12. Hand hygiene (over gloves) performed using ABHR
13. Switch off the respirator unit and detach the breathing tube from the hood
14. Working together, the buddy and staff member carefully remove the respirator hood, the staff member will lean forward and the buddy will remove the hood by holding the sides and gently pulling up and away from the staff members face.
15. Buddy performs hand hygiene (over gloves) using ABHR

	16. Inner gloves removed 17. Hand hygiene performed using ABHR 18. Wellington boots removed using either a boot remover tool or by toeing off. 19. All PPE appropriately discarded 20. Hand hygiene performed using liquid soap and water **Decontamination procedure** • Powered respirators used for AGPs (not IDHC) must be decontaminated after each use following the manufacturer's instructions (see example in appendix 1) and a record kept. • Powered respirators used in the care of patients with IDHC must be treated as single-use disposable items and disposed of as clinical waste immediately after use. **When to change filters** Filters should be replaced according to the manufacturer's instruction and: • if visibly damaged; • if visibly dirty; • if contaminated with blood or body fluids; • when breathing resistance increases; • after each use for patients with known or suspected infectious disease of high consequence.

Reference List

(1) Health Protection Scotland. Personal Protective Equipement (PPE) for Infectious Diseases of High Consequence (IDHC). 31-3-2017 http://www.nipcm.hps.scot.nhs.uk/resources/literature-reviews/transmission-based-precautions-literature-reviews/

(2) Centers for Disease Control and Prevention (CDC). Guidance on Personal Protective Equipment (PPE) To Be Used By Healthcare Workers during Management of Patients with Confirmed Ebola or Persons under Investigation (PUIs) for Ebola who are Clinically Unstable or Have Bleeding, Vomiting, or Diarrhea in U.S. Hospitals, Including Procedures for Donningand Doffing PPE. 27-8-2015 http://www.cdc.gov/vhf/healthcare-us/ppe/guidance.html

(3) Beam EL, Schwedhelm S, Boulter K, Kratochvil C, Lowe J, Hewlett A, et al. Personal protective equipment processes and rationale for the Nebraska Biocontainment Unit during the 2014 activations for Ebola virus disease. American Journal of Infection Control 2016;44(3):01.

(4) Health Protection Scotland. National Infection Prevention and Control Manual. 2017 http://www.nipcm.hps.scot.nhs.uk/

(5) Health and Safety Executive (HSE). Respiratory Protective Equipment at Work: A practical guide. 2013 http://www.hse.gov.uk/pubns/priced/hsg53.pdf

(6) 3M Technical Data Bulletin: Respiratory Protection for Airborne Exposures to Biohazards. 2009 multimedia.3m.com/mws/media/.../respiratory-protection-against-biohazards.pdf

Appendix 1:

Example protocol for decontamination of powered respirators – adapted from 3M™ Jupiter™ Powered Air Blower/Filtration Unit

Always consult the manufacturer's instructions for decontaminating equipment.

1. **Disconnect breathing tube from any attached headgear.**

2. **Disconnect the other end of the breathing tube from the powered respirator assembly.**

3. **Remove the blower assembly from the waist belt.**

4. **Clean headgear:**
   Wipe down with a soft cloth dampened with neutral detergent solution. Rinse with clean water. Do not soak hoods during cleaning.

5. **Disinfect headgear:**
   Wipe headgear components with a clean soft cloth dampened with a disinfectant solution (*e.g.* a 0.1% chlorine solution or a solution containing 1000 ppm available chlorine). Alternatively, a combined detergent/disinfectant may be used.
   Do not soak hoods.

6. **Rinse headgear:**
   Wipe all components cleaned with a clean soft cloth dampened with clean warm water. Note: It is important to rinse off chlorine based products. While rinsing is preferred, certain other disinfectants may not require this step. Follow the user instructions for the product selected." Ensure all headgear components are allowed to completely air dry prior to reuse or storage.

   Clean the remaining parts of the system as follows. You should not use solvents to clean the motor/blower unit or battery case as they may chemically weaken the plastics. Do not use detergents that contain lanolin or other oils, gasoline (petrol), chlorinated degreasing fluids (such as trichloroethylene), organic solvents or abrasive cleaning agents.

7. **Remove the filter cartridges from the turbo PAPR blower assembly.**
   Dispose of or reuse filter/cartridge according to infection control policy and/or service life determination. Properly dispose of the used filter/cartridge according to local regulations. For cleaning for reuse, wipe down the exterior of the filter/cartridge body with a mild cleaning solution. Do not allow liquid to enter the cartridge body. Do not attempt to clean the media inside of the filter/cartridge body.

8. **Wipe the battery pack with a mild cleaning solution.**
   Remove the battery pack and wipe down with a soft cloth dampened with a neutral solution. Rinse with clean water. Do not immerse the battery pack.

9. **Clean the breathing tube**.
   Wipe down with a soft cloth dampened with a neutral detergent solution. If needed, rinse in a similar fashion with clean water. Air dry in an uncontaminated atmosphere. Alternatively, the breathing tube can be immersed in the cleaning solution. If this is done, the breathing tube must be rinsed in clean water, hung vertically and allowed to completely air dry prior to reuse or storage. The breathing tube can also be connected to the motor blower and air forced through the breathing tube until dry.

10. **Clean the blower unit.**
    Wipe down with a soft cloth dampened with a neutral detergent solution. If needed, rinse in a similar fashion with clean water. Do not immerse the blower unit. Be careful not to let any of the cleaning solution enter into the blower unit. Air dry in an uncontaminated atmosphere.

11. **Disinfect respirator components.**
    Wipe components with a clean soft cloth dampened with a hospital disinfectant (*e.g.* a 0.1% chlorine solution or a solution containing 1000 ppm available chlorine).

12. **Rinse respirator components.**
    Wipe all components cleaned with a clean soft cloth dampened with clean warm water. Note: It is important to rinse off chlorine based products.

13. **Ensure all components are dry prior to use or storage.**

14. **Reassemble unit as described in the manufacturer's instructions.**